



TETRA TECH, INC.

TECHNICAL MEMORANDUM

Basewide Groundwater Monitoring Program Report
Spring 2005
Installation Restoration Program Site 2
Vandenberg Air Force Base, California

01 September 2005

Prepared by:
Tetra Tech, Inc.
4213 State Street, Suite 100
Santa Barbara, California 93110

1.0 INTRODUCTION

This report documents the activities and results of the spring 2005 groundwater monitoring at Installation Restoration Program Site 2 (Old Base Service Station, or OBSS), Operable Unit 6, Vandenberg Air Force Base (AFB), Santa Barbara County, California. Samples were collected at Site 2 by Tetra Tech, Inc. (Tetra Tech) during May 2005. The location of Site 2 is shown on Figure 1.

The groundwater monitoring is being completed in accordance with the Basewide Groundwater Monitoring Program (BGMP) Work Plan (U.S. Air Force 2000a), the BGMP Health and Safety Plan Addendum (U.S. Air Force 2000b), the Basewide Sampling and Analysis Plan (U.S. Air Force 2003), the BGMP Quality Assurance Project Plan (QAPP) Addendum (U.S. Air Force 2004a), the Vandenberg AFB Hazardous Waste Management Plan (U.S. Air Force 2002), and the Waste Management Plan Addendum (U.S. Air Force 2005a). Regulatory oversight of the work is being performed by the California Department of Toxic Substances Control (DTSC) and Regional Water Quality Control Board—Central Coast Region (RWQCB).

Site background information is summarized in Section 2.0. The scope of work and methodology for groundwater monitoring are presented in Section 3.0. The results of the quarterly monitoring are presented in Section 4.0. Quality Assurance/Quality Control is discussed in Section 5.0. Recommendations for future sampling are presented in Section 6.0.

2.0 BACKGROUND

2.1 SITE DESCRIPTION AND HISTORY

Installation Restoration Program Site 2 is located in the main cantonment area, north of the intersection of Wyoming and Summersil Avenues. In early 2000, a Tee-Ball field was constructed that covers the majority of the Site (Figure 1). The Child Development Center playground is located to the northeast.

The OBSS had a service station building and three pump islands on a 200-foot by 200-foot asphalt lot. The site had four 10,000-gallon gasoline underground storage tanks (USTs), a 500-gallon aboveground waste oil tank, and an oil/water separator. The OBSS dispensed leaded and unleaded gasoline from 1941 until 1981.

All structures, tanks, and piping associated with the OBSS were removed between 1981 and 1998 (HydroGeoLogic [HGL] 2001). All four gasoline USTs, which were located at the northwest corner of the site, were removed in 1981. In 1992, Jacobs Engineering Group, Inc. (JEG) removed the concrete oil/water separator and fuel distribution piping (HGL 2001). In 1998, the 500-gallon waste oil tank was removed. During the removal of the OBSS building, the pump islands, and the pavement in 1998, monitoring wells 2-MW-2, and OS-MW-4 reportedly were destroyed and wells OS-MW-3A and OS-MW-2 were damaged (HGL 2001).

In 1999, IT Corporation, Inc. (IT) began investigations at the site. In September 1999, IT conducted a shallow soil investigation. HGL continued the investigation and, in November 1999, removed 170 cubic yards of soil below the former location of the two easternmost pump islands (along the southern portion of the site) (HGL 2001). The Tee-Ball field was built several months after completion of the excavation activities (Martinez 2001).

During the construction of the Tee-Ball field and the realignment of Wyoming Avenue and Utah Avenue, monitoring wells 2-MW-5 through 2-MW-9, OS-MW-3A, and OS-MW-4 were buried under fill material. Wells 2-MW-5 through 2-MW-9 were subsequently found and are not damaged. In September 2000,

Tetra Tech was requested to determine the condition of wells OS-MW-2, OS-MW-3A, and OS-MW-4. Well OS-MW-2 was found and was determined to be undamaged. Tetra Tech was unable to find monitoring wells OS-MW-3A and OS-MW-4 due to the amount of fill material covering them. The condition of these wells is unknown; however, it appears likely they have been destroyed. In a letter dated 06 February 2001 the Air Force recommended no further search for these wells. The RWQCB concurred with this recommendation in a letter dated 15 March 2001.

In February 2002, Tetra Tech installed a remote sampling system for wells 2-MW-5, 2-MW-7, 2-MW-8, and 2-MW-9 at Site 2. The system was designed to facilitate quarterly sampling of these wells, which are buried under the Tee-Ball field, without delaying use of the Tee-Ball field or impacting the condition of the grass on the field or surrounding grounds.

The remote sampling system was installed with watertight well caps and continuous tubing. The static water levels of these wells are measured using a pressure transducer that calculates the height of a water column above an open-ended tube suspended in the casing. The pressure transducer is zeroed to ambient pressure before the first reading is taken. Since the wells are sealed to prevent surface water intrusion, the air inside the casings is no longer at ambient pressure. For this reason the static water levels measured by the remote sampling system may be different from what is measured by the pressure transducer.

2.2 HYDROGEOLOGY

Site 2 is located on Burton Mesa, where groundwater typically occurs unpredictably in small lenses perched on low-permeability layers. At Site 2, groundwater is encountered in apparently discontinuous perched lenses in the unconsolidated sediments overlying Monterey Formation bedrock and, more importantly, in fractured cherts and porcelanites (HGL 2001). Groundwater occurring in this fractured zone within the Monterey Formation represents the groundwater monitoring network sampled under the BGMP at Site 2.

Groundwater depths range from 14 to 31 feet below ground surface. However, groundwater was encountered during drilling at approximately 10 feet below the static level measured in the monitoring wells (HGL 2001).

Groundwater levels measured in May 2005 indicate that the groundwater elevation ranged from approximately 450 to 454 feet above mean sea level (Table 1). Based on data from this quarter, the interpreted direction of groundwater flow at Site 2 was to the northwest with an average hydraulic gradient of 0.007 feet per foot (Figure 1).

Monitoring wells at Site 2 are screened between 411.3 and 452.5 feet above mean sea level (U.S. Air Force 2004b). According to the Supplemental RI Report completed by HGL, the deep groundwater zone occurs below lenses of relatively impermeable material. The boring logs of monitoring wells sampled as part of the BGMP show groundwater encountered at depths below laminated mudstone, silty clay, or clay layers (HGL 2001). Therefore, the groundwater sampled as part of the BGMP is from the deep groundwater zone.

3.0 SCOPE OF WORK

The work performed during spring 2005 at Site 2 included measuring groundwater elevations, collecting groundwater samples for laboratory analysis, and preparing this report.

3.1 GROUNDWATER MONITORING METHODOLOGY

Three wells were sampled at Site 2 during spring 2005. Dedicated MicroPurge pumps were used for purging and sampling groundwater at wells 2-MW-8, 2-MW-11, and 2-MW-12. Sampling was conducted in accordance with the documents cited in Section 1.0. Measured groundwater elevations are presented in Table 1 and groundwater contours are illustrated on Figure 1. Purge records are provided in Appendix A.

In general, wells were purged until a minimum of one pump and tubing volume of water was removed and water quality parameters had stabilized. Criteria for determining stabilization are three successive measurements of temperature within ± 0.1 degree Celsius, pH within ± 0.1 , conductivity within ± 5 percent, and a turbidity reading of less than 5 nephelometric turbidity units (NTUs). In cases where stability or a turbidity reading of less than 5 NTUs was not obtained, samples were collected after purging a minimum of five pump and tubing volumes of water.

3.1.1 MicroPurge Groundwater Sampling

MicroPurge sampling was conducted at all monitoring wells sampled at Site 2 during spring 2005. The pumping rates were calibrated for each well prior to purging to maintain a static water level (i.e., minimal drawdown). Due to high turbidity, well 2-MW-12 was sampled after purging at least five pump and tubing volumes of water.

4.0 RESULTS

Temperature, conductivity, pH, and turbidity were measured during purging and sampling. Field parameter readings measured immediately prior to sampling are presented in Table 2. Fixed laboratory analyses were performed by EMAX Laboratories, Inc. in Torrance, California. Samples were analyzed according to the work plan (U.S. Air Force 2000a) for dissolved metals by U.S. Environmental Protection Agency (EPA) methods SW6010B and SW7470A, volatile organic compounds (VOCs) by EPA method SW8260B, semivolatile organic compounds (SVOCs) by EPA method SW8270C, and polynuclear aromatic hydrocarbons (PAHs) by EPA method SW8270C with selected ion monitoring (SIM). Laboratory analyses and data validation were conducted according to the QAPP Addendum (U.S. Air Force 2004a). Data validation was performed on 100 percent of the analytical data. Analytical results are presented in Tables 3 through 5 and on Figure 2. A historical summary of key contaminants of concern (COCs) is presented in Table 6 and on Figures 3A and 3B. Figure 3A contains historical data for key COCs from December 1999 through fall 2003 and Figure 3B contains historical data for key COCs from winter 2004 to present. Chain-of-custody records are provided in Appendix B.

4.1 METALS

Groundwater samples collected from the three wells sampled at Site 2 this quarter were analyzed for dissolved metals. Dissolved metal concentrations were compared to the 95th percentile background threshold values (BTVs) for groundwater (JEG 1994).

Aluminum was detected above the BTV of 1,200 micrograms per liter ($\mu\text{g/L}$) and the primary maximum contaminant level (MCL) of 1,000 $\mu\text{g/L}$ in groundwater collected from well 2-MW-8 at a concentration of 5,430 $\mu\text{g/L}$ (Table 3 and Figure 2).

Beryllium was detected above the BTV of 0.3 $\mu\text{g/L}$ and the primary MCL of 4 $\mu\text{g/L}$ in groundwater from well 2-MW-8 at a concentration of 7.82 $\mu\text{g/L}$.

Cadmium was detected above the BTV of 5 µg/L and the primary MCL of 5 µg/L in the groundwater sample from well 2-MW-8 at a concentration of 36.8 µg/L.

Selenium was detected above the BTV of 3 µg/L in groundwater samples from wells 2-MW-8 and 2-MW-11 at concentrations of 39.4 and 45.6 µg/L, respectively.

Thallium was detected above the BTV of 1 µg/L and the primary MCL of 2 µg/L in groundwater collected from all three wells at concentrations ranging from 5.5 to 11.1 µg/L.

In addition, arsenic, barium, calcium, cobalt, magnesium, molybdenum, potassium, and sodium were detected at concentrations above their respective BTVs in one or more Site 2 wells. The dissolved metals concentrations detected during spring 2005 were within the range of those previously detected with the exception of the thallium concentration in groundwater from well 2-MW-8, which was lower than those previously detected (Table 6 and Figures 3A and 3B).

4.2 VOLATILE ORGANIC COMPOUNDS

The groundwater sample collected from well 2-MW-8 was analyzed for VOCs. Benzene was detected above the primary MCL of 1 µg/L at a concentration of 36 µg/L (Table 4). Ethylbenzene, m,p-xylene, o-xylene, and toluene were not detected above their respective MCLs.

Concentrations of benzene, ethylbenzene, and xylenes detected in groundwater from well 2-MW-8 have increased by more than one order of magnitude since December 1999 (Table 6). All of the benzene concentrations detected in groundwater from well 2-MW-8 since December 1999 have been above the MCL of 1 µg/L, with the largest increase in concentration occurring between fall 2001 and winter 2002, which coincides with the installation of the MicroPurge pump during winter 2002 (Figures 3A and 3B). Please note that concentrations of benzene in this well have been increasing steadily since this time. Concentrations of benzene in wells surrounding well 2-MW-8 were consistently below the MCL in well 2-MW-7 and consistently ND in well 2-MW-9 since fall 2000.

4.3 SEMIVOLATILE ORGANIC COMPOUNDS AND POLYNUCLEAR AROMATIC HYDROCARBONS

The groundwater sample collected from well 2-MW-8 was analyzed for both SVOCs and PAHs.

Naphthalene was detected in groundwater from well 2-MW-8 at a concentration of 22 µg/L using EPA method SW8270C and 18 µg/L using EPA method SW8270C with SIM (Table 5). Groundwater collected from well 2-MW-8 also contained 2-methylnaphthalene at a concentration of 25 µg/L.

Naphthalene has been detected in groundwater collected from well 2-MW-8 since December 1999 at concentrations ranging from 1.07 µg/L (December 1999) to 28.8 µg/L (winter 2004) (Table 6). Since December 1999, naphthalene has been detected at concentrations above the California Department of Health Services (DHS) notification level of 17 µg/L during seven quarters including spring 2005. The compound 2-methylnaphthalene has been detected in groundwater collected from well 2-MW-8 since summer 2001 at concentrations ranging from 5.7 µg/L (fall 2001) to 38.2 µg/L (winter 2004) (U.S. Air Force 2005b). The general trend for both compounds has been toward increasing concentrations until winter 2004 followed by a decrease in concentrations during spring 2004. Since spring 2004, naphthalene and 2-methylnaphthalene concentrations have increased.

Although naphthalene and 2-methylnaphthalene are not classified as carcinogens by the U.S. EPA (U.S. EPA 2005), the State of California considers naphthalene a carcinogen. However, a benzo(a)pyrene

potency equivalency factor (PEF) has not yet been established by the State of California. A benzo(a)pyrene PEF is not available for either compound (DTSC 1999). Thus, the naphthalene and 2-methylnaphthalene results for groundwater from well 2-MW-8 cannot be evaluated using PEFs as discussed in the State's comments on the winter 2004 Site 2 report.

5.0 QUALITY ASSURANCE/QUALITY CONTROL

All of the analytical data presented in this report have been validated according to the QAPP Addendum (U.S. Air Force 2004a). The data validation process includes review of sample preservation, temperature, and hold times; detection and quantitation limits; instrument calibration; and equipment blank, trip blank, method blank, laboratory control sample, and matrix spike/matrix spike duplicate. Data validation qualifiers and comments are provided on the data tables to indicate the results of the data validation and to quantitatively indicate the usability of the data. In addition, field sampling records are reviewed to assess the potential for any field conditions to adversely impact the data quality.

There were no significant quality assurance/quality control discrepancies with the data presented in this report. The data quality objectives for the spring 2005 sampling at Site 2 were achieved.

6.0 RECOMMENDATIONS

The recommendation included in the Winter 2005 Groundwater Monitoring Report is presented below:

1. Tetra Tech and the Air Force recommended PAH analyses be continued quarterly at well 2-MW-8 and semiannually during winter and summer quarters at well OS-MW-2. Comments on the winter 2005 reports had not been received at the time of this report.

One new recommendation is presented below:

1. Tetra Tech and the Air Force recommend that mercury be removed from the analyte list for metals at Site 2 beginning in fall 2005. Mercury has not been detected above the BTV in groundwater from any Site 2 well since spring 2003. A table of historic mercury concentrations and a time versus concentration plot of mercury concentrations is included in Appendix C.

These recommendations were developed in accordance with the Air Force Center for Environmental Excellence Long-Term Monitoring Optimization Guide (U.S. Air Force 1997) and the decision tree developed by Tetra Tech for the BGMP at Vandenberg AFB (Tetra Tech 2002). Using the decision tree, mercury concentrations were evaluated. Concentrations were not increasing; there is no MCL for mercury but concentrations have been below the BTV since spring 2003. No mercury plume exists at the site. This analysis is appropriate for removal from the sampling plan.

The summer 2005 sampling will be conducted according to the work plan (U.S. Air Force 2000a).

7.0 REFERENCES

California Environmental Protection Agency (Cal/EPA) Department of Toxic Substances Control (DTSC)

1999 *Preliminary Endangerment Assessment Guidance Manual.*

HydroGeoLogic, Inc. (HGL)

2001 *Supplemental Remedial Investigation Report, Site 2-Old Base Service Station, Vandenberg AFB, California. Final.* Prepared for the Air Force Center for Environmental Excellence. December.

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2004b *Basewide Groundwater Monitoring Program Report, Summer 2004, Installation Restoration Program Site 2, Vandenberg Air Force Base, California.* Prepared for Department of the Air Force 30 CES/CEVR, 806 13th Street, Suite 116, Vandenberg Air Force Base, California, and Department of the Air Force, Headquarters Air Force Center for Environmental Excellence/ICS, 3300 Sidney Brooks, Brooks City-Base, Texas. Prepared by Tetra Tech, Inc. December.

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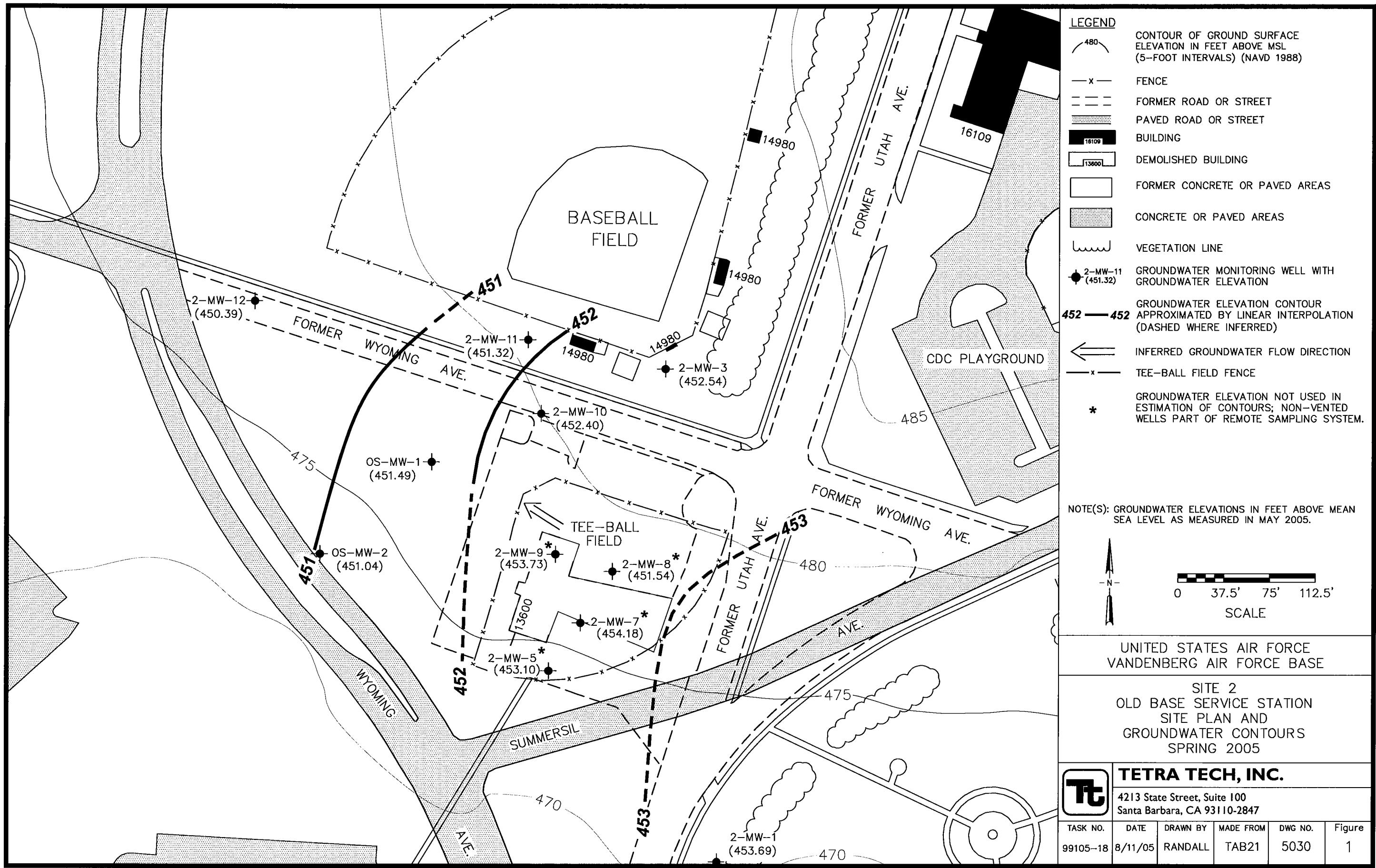
2005a *Waste Management Plan Addendum. Final.* 730 CES/CEVR, Installation Restoration Program, Vandenberg Air Force Base, California, and Headquarters Air Force Space Command, Peterson Air Force Base, Colorado. Prepared by Tetra Tech, Inc. February.

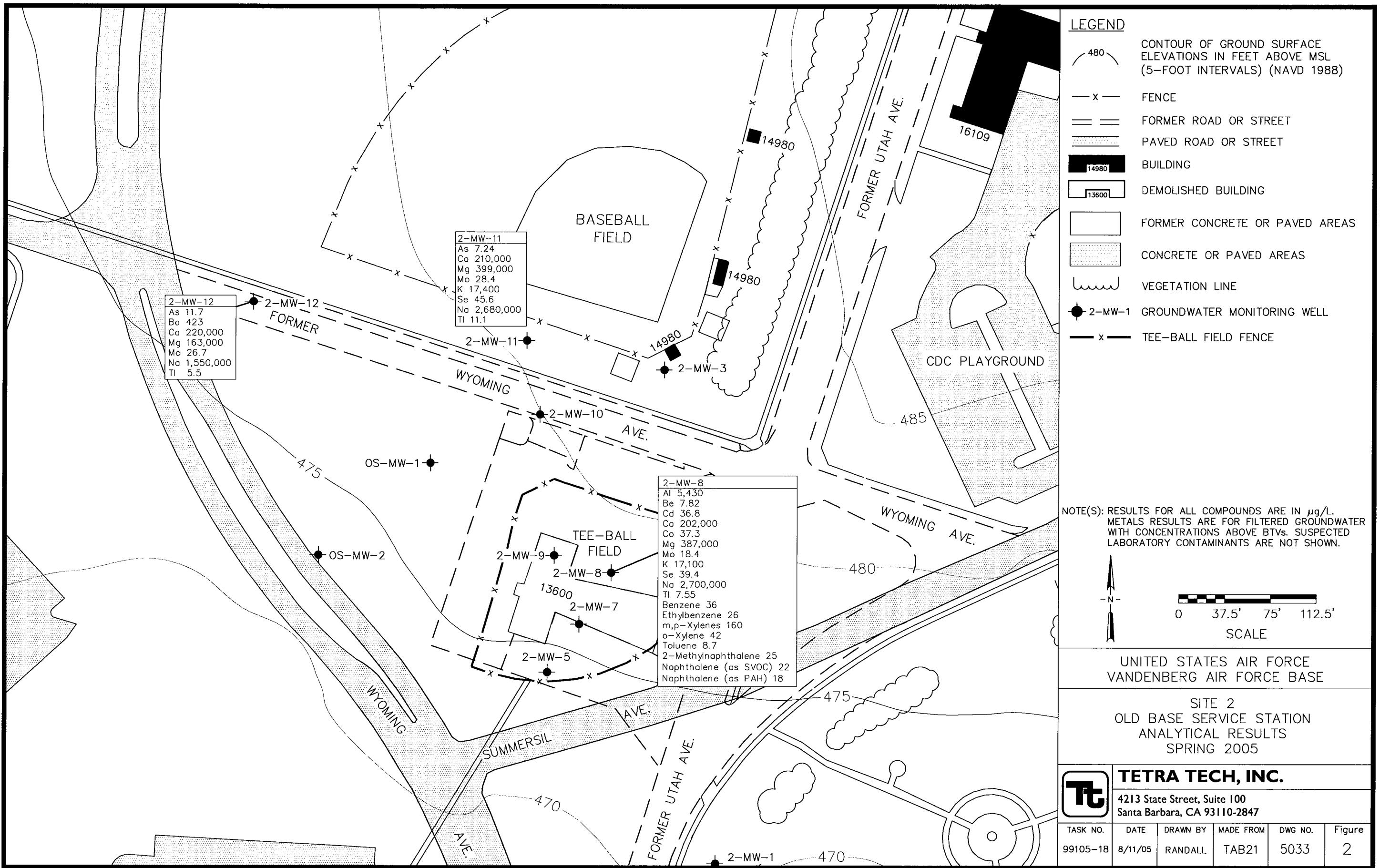
U.S. Air Force

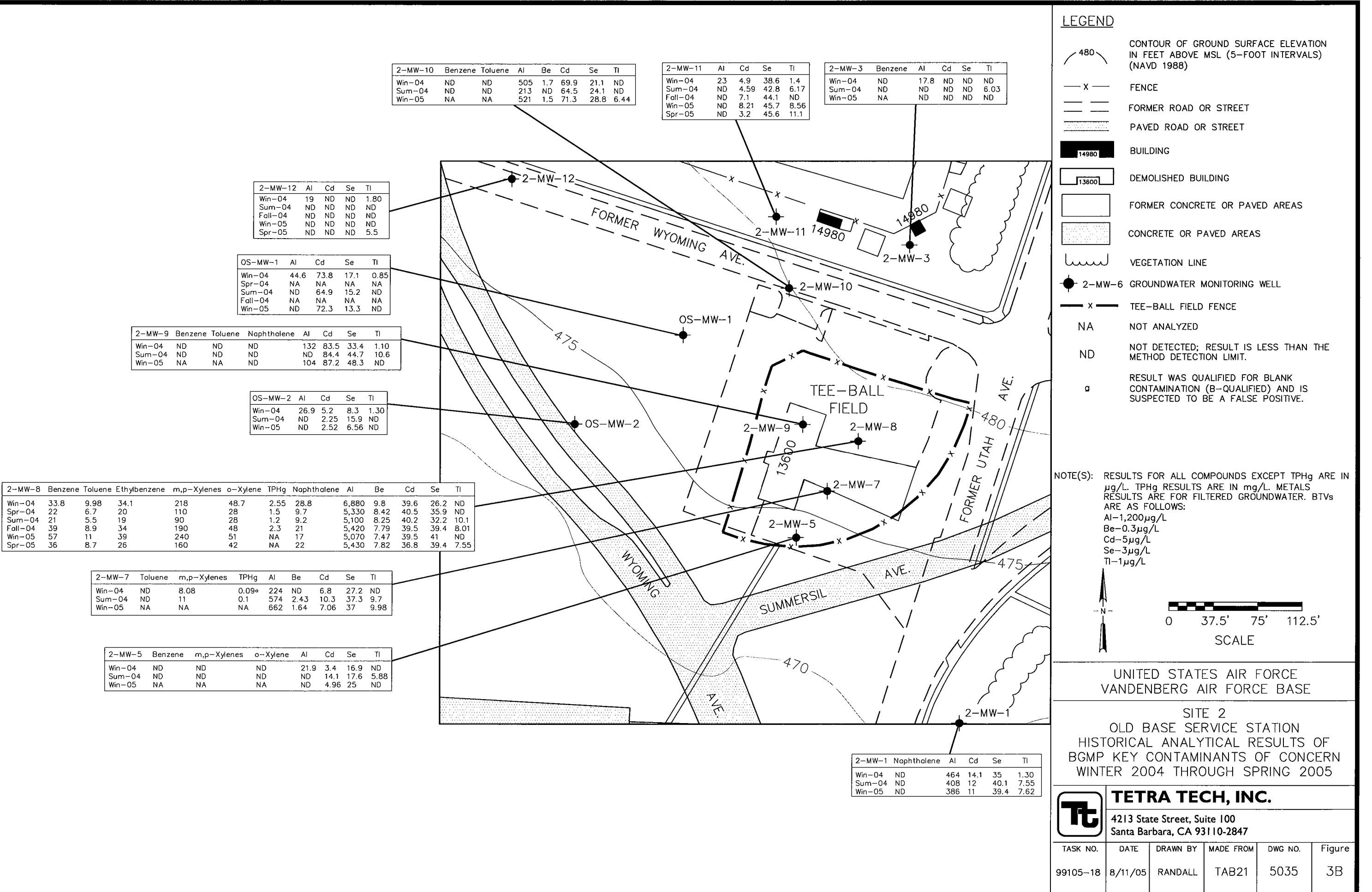
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U.S. Environmental Protection Agency (EPA)

2005 Integrated Risk Information System (IRIS). On-line database available at: <http://www.epa.gov/iris/>.







	Benzene	Toluene	Naphthalene	AI	Be	Cd	Se	Tl
Dec-99	0.0472	ND	0.137	NA	NA	60.2	NA	NA
Fall-00	ND	ND	ND	ND	ND	80.4	23.5	ND
Win-01	ND	ND	ND	ND	ND	78.8	14.3	ND
Spr-01	ND	0.53	ND	ND	ND	76.3	20.9	ND
Sum-01	ND	ND	ND	232	ND	77.4	32.3	ND
Fall-01	ND	ND	ND	277	ND	88.1	27.4	71.1
Win-02*	ND	ND	ND	651	ND	71.8	22.6	ND
Sum-02	ND	ND	NA	341	ND	87.5	9.67	ND
Win-03	ND	ND	NA	622	ND	11.3	20.8	ND
Sum-03	ND	ND	NA	939	2.7	59.7	23.9	ND

	Cd	AI	Se	Se	Tl
Spr-01	36.3	ND	ND	ND	ND
Sum-01	36.1	ND	ND	ND	ND
Fall-01	31.6	ND	ND	66.1	69.7
Win-02*	ND	284	ND	ND	ND
Spr-02	12.7	186	ND	ND	ND
Sum-02	17.4	ND	ND	ND	ND
Fall-02	ND	ND	40.7	ND	ND
Win-03	8.12	ND	52.1	ND	ND
Spr-03	1.9	26.6	ND	ND	ND
Fall-03	ND	33.6	3.3	ND	ND

	Cd	AI	Se	Tl
Spr-01	5.87	ND	25.3	ND
Sum-01	5.39	ND	24.1	ND
Fall-01	7.18	ND	25.2	66.1
Win-02*	4.33	341	25.8	ND
Spr-02	5.11	242	55	ND
Sum-02	5.8	ND	23.7	ND
Fall-02	4.56	ND	87.5	ND
Win-03	5.74	ND	148	ND
Spr-03	5	33.2	36.3	ND
Sum-02	ND	ND	5.98	ND
Win-03	ND	ND	4.17	23.1
Sum-03	ND	ND	ND	ND

	Benzene	AI	Cd	Se	Tl
Dec-99	0.0465	NA	2.32	NA	NA
Fall-00	ND	ND	12	ND	ND
Win-01	ND	ND	ND	ND	ND
Spr-01	ND	ND	4.13	ND	ND
Sum-01	ND	ND	6.6	ND	ND
Fall-01	ND	ND	2.05	ND	44.9
Win-02*	ND	ND	5.84	ND	ND
Spr-02	ND	118	7	ND	ND
Sum-02	ND	ND	5.98	ND	ND
Win-03	ND	ND	4.17	23.1	ND
Sum-03	ND	ND	ND	ND	ND

	AI	Cd	Se	Tl
Dec-99	NA	38.1	NA	NA
Fall-00	ND	85.6	14.8	ND
Win-01	ND	54.7	9.11	ND
Spr-01	ND	54.5	16.3	ND
Sum-01	ND	50.8	15.8	ND
Fall-01	ND	60.5	13.6	65.2
Win-02*	313	46.6	ND	ND
Spr-02	NA	NA	NA	NA
Sum-02	ND	58.8	ND	ND
Fall-02	NA	NA	NA	NA
Win-03	ND	63.2	58.3	ND
Spr-03	NA	NA	NA	NA
Sum-03	42.8	64.7	18	ND
Fall-03	NA	NA	NA	NA

	Benzene	Toluene	Naphthalene	AI	Cd	Se	Tl
Dec-99	0.0485	ND	0.205	NA	42.3	NA	NA
Fall-00	ND	ND	ND	ND	34	43.4	ND
Win-01	ND	ND	ND	ND	74.5	37.5	ND
Spr-01	ND	0.59	ND	ND	268	76.5	40.3
Sum-01	ND	ND	ND	ND	81.1	42.0	ND
Fall-01	ND	ND	ND	ND	483	96	47.8
Win-02*	ND	ND	ND	ND	548	72.1	31.1
Sum-02	ND	ND	ND	ND	73.4	31.2	ND
Win-03	ND	ND	ND	ND	265	12.4	88.6
Sum-03	ND	ND	ND	ND	284	85.8	56.7

	Cd	AI	Se	Tl
Spr-01	6.82	ND	10.7	ND
Sum-01	13.9	ND	13.6	ND
Fall-01	2.56	ND	38.5	ND
Win-02*	10.9	211	ND	ND
Sum-02	10.3	ND	ND	ND
Win-03	10.4	ND	34.4	ND
Sum-03	9.8	20.1	12.3	ND

	Benzene	Toluene	Ethylbenzene	m,p-Xylenes	o-Xylene	TPHg	Naphthalene	AI	Be	Cd	Se	Tl
Dec-99	0.375	2.06	1.38	6.26	2.21	1.9	1.07	NA	NA	22.40	NA	NA
Fall-00	3.5	5.3	5.2	29	6.0	0.69	ND	1,380	ND	6.74	37.7	ND
Win-01	4.40	11	10	42	14	0.62	ND	1,260	ND	35.2	36.3	ND
Sum-01	5.1	11	8.7	37	12	0.88	5.3	1,650	ND	34	37.5	ND
Fall-01	5.3	6.4	4.9	37	10	0.64	ND	1,970	ND	38.7	43.2	76.9
Win-02*	36	64	62	250	74	4.9	21	13,500	12.7	35	ND	ND
Spr-02	7.7	12	12	61	21	1.2	10	12,700	13.1	37	35.2	ND
Sum-02	23	35	37	160	53	2.8	18	12,300	12.2	34.8	ND	ND
Fall-02	18	23	31	72	35	2.3	12	3,970	7.02	26.4	21.3	14.8
Win-03	26	37	36	180	52	3.6	16	7,410	11.3	38.9	88	ND
Spr-03	32.5	22.7	34.7	230	56.2	2.72	15.2	8,600	10.3	41.6	26.7	ND
Sum-03	22.5	12.1	32.3	125	24.7	2.12	18.5	8,320	10	39.8	43.1	ND
Fall-03	33.0	24.1	26.9	227	61.6	2.27	25.7	9,300	10.9	38.9	30.7	ND

	Toluene</th

Table 1
Groundwater Elevations
IRP Site 2 (Old Base Service Station)
Vandenberg AFB, California

Monitoring Well	Top of Casing Elevation (feet above msl)	Date Measured	Groundwater Depth (feet below TOC)		Groundwater Elevation (feet above msl)		
			Spring 2005	Spring 2005	Spring 2005	Winter 2005	Fall 2004
2-MW-1	468.26	02-May-05	14.57	453.69	452.91	452.54	452.88
2-MW-3	482.84	02-May-05	30.30	452.54	451.72	451.44	451.60
2-MW-5 ^a	474.50	02-May-05	21.40	453.10	451.73	451.95	451.69
2-MW-7 ^a	475.39	02-May-05	21.21	454.18	451.86	452.27	452.29
2-MW-8 ^a	476.51	02-May-05	24.97	451.54	452.61	452.65	444.86
2-MW-9 ^a	476.24	02-May-05	22.51	453.73	452.91	452.08	451.59
2-MW-10	479.94	02-May-05	27.54	452.40	451.55	451.37	451.54
2-MW-11	482.10	02-May-05	30.78	451.32	450.49	450.14	450.52
2-MW-12	477.77	02-May-05	27.38	450.39	449.37	449.40	449.73
OS-MW-1	476.28	02-May-05	24.79	451.49	450.63	450.29	450.73
OS-MW-2	471.50	02-May-05	20.46	451.04	450.25	449.92	450.28

Definition(s):

- msl - mean sea level
- TOC - top of well casing

Note(s):
^a - Non-vented well; part of remote sampling system.

Table 2
Water Quality Parameters
Spring 2005
IIRP Site 2 (Old Base Service Station)
Vandenberg AFB, California

Sampling Location	2-MW-8	2-MW-11	2-MW-12
Sample ID	V2MW8	V2MW11	V2MW12
Collection Date	02-May-05	02-May-05	02-May-05
Field Parameters¹:			
Temperature (°Celsius)	19.93	18.93	19.65
Conductivity ($\mu\text{mhos/cm}$)	12,321	12,194	7,386
pH	4.89	5.97	8.71
Turbidity (NTUs)	1.29	4.08	13.8

Definition(s):

- $\mu\text{mhos/cm}$ - micromhos per centimeter
- NTU - nephelometric turbidity unit

Note(s):
 1 - Field parameters measured immediately prior to sampling.

Table 3
Metals in Groundwater
Spring 2005
EPA Methods SW6010B and SW7470A (µg/L)
IRP Site 2 (Old Base Service Station)
Vandenberg AFB, California

Sample Location	Sample ID	Collection Date	Dissolved Metals	MDL ¹	PQL ¹	Primary MCL	BTW	2-MW-8 V2MW8F 02-May-05	2-MW-11 V2MW11F 02-May-05	2-MW-12 V2MW12F 02-May-05
Aluminum	15	60	1,000	1,200	5.430	g	60	U g	60	U g
Antimony ²	40	100	6	10	40	U g	40	U g	40	U g
Arsenic	4	10	50	7	6.39	J q	7.24	J q	11.7	g
Barium	1	5	1,000	276	133	g	104	g	423	g
Beryllium ²	1	5	4	0.3	7.82	g	1	U g	1	U g
Cadmium	1	5	5	5	36.8	g	3.2	J q	2	U g
Calcium	22	500	N/A	197,000	202,000	g	210,000	g	220,000	g
Chromium	1	10	50	20	5	U g	5	U g	5.63	J q
Cobalt	2	15	N/A	13	37.3	g	5	U g	8.09	J q
Copper	1	10	1,300	58	24.5	g	5	U g	5	U g
Iron	4	100	N/A	3,530	124	g	40	U g	40	U g
Lead	2	3	15	3	2	U g	2	U g	2	U g
Magnesium	26	200	N/A	119,000	387,000	g	399,000	g	163,000	g
Manganese	1	5	N/A	971	152	g	38	g	139	g
Mercury	0.09	0.3	N/A	0.2	0.1	U g	0.1	U g	0.1	U g
Molybdenum	2	15	N/A	12	18.4	g	28.4	g	26.7	g
Nickel	5	20	100	490	206	g	84.3	g	34.7	g
Potassium	41	1,000	N/A	13,300	17,100	g	17,400	g	11,000	g
Selenium ²	5	10	50	3	39.4	g	45.6	g	5	U g
Silver ²	1	10	N/A	0.2	5	U g	5	U g	5	U g
Sodium	23	500	N/A	420,000	2,700,000	g	2,680,000	g	1,550,000	g
Thallium ²	5	10	2	1	7.55	J q	11.1	g	5.5	J q
Vanadium	1	10	N/A	28	5	U g	5	U g	5	U g
Zinc	2	20	N/A	80	65.6	g	12.6	J q	5	U g

Table 3
Metals in Groundwater
Spring 2005
EPA Methods SW6010B and SW7470A (µg/L)
IRP Site 2 (Old Base Service Station)
Vandenberg AFB, California

Data Validity Qualifier(s):	
J	- The analyte was positively identified and the result is usable; however, the analyte concentration is an estimated value.
U	- The analyte was not detected at or above the MDL.
Data Validity Comment(s):	
g	- The data met prescribed criteria as detailed in the QAPP.
q	- The analyte detection was below the PQL.
Definition(s):	
BTV	- background threshold value
MCL	- maximum contaminant level
MDL	- method detection limit
µg/L	- micrograms per liter
N/A	- not applicable
PQL	- practical quantitation limit
QAPP	- Quality Assurance Project Plan
Note(s):	
	Bold type indicates results that were above the MCL.
	Shading indicates results that were above the 95th percentile BTV.
1	- Values from QAPP Addendum (U.S. Air Force 2004a).
2	- The BTV was less than the detection limit for this metal.

Table 4
VOCs in Groundwater
Spring 2005
EPA Method SW8260B (µg/L)
IRP Site 2 (Old Base Service Station)
Vandenberg AFB, California

Sample Location				2-MW-8
Sample ID				V2MW8M
Collection Date				02-May-05
	MDL ¹	PQL ¹	Primary MCL	
Benzene	0.07	0.4	1	36 J b, c
Ethylbenzene	0.12	1.0	300	26 J b
m,p-Xylene	0.25	2.0	1,750 ²	160 J b
o-Xylene	0.13	1.0	1,750 ²	42 J b
Toluene	0.11	1.0	150	8.7 J b
All other target analytes	N/A	N/A	N/A	ND

Data Validity Qualifier(s):

- J - The analyte was positively identified and the result is usable; however, the analyte concentration is an estimated value.

Data Validity Comment(s):

- b - The surrogate spike recovery was outside quality control criteria.
 c - The matrix spike and/or matrix spike duplicate recoveries were outside control limits.

Definition(s):

- MCL - maximum contaminant level
- MDL - method detection limit
- µg/L - micrograms per liter
- N/A - not applicable
- ND - not detected; result is less than the MDL
- PQL - practical quantitation limit
- QAPP - Quality Assurance Project Plan

Note(s):

Bold type indicates results that were above the MCL.

- 1 - Values from QAPP Addendum (U.S. Air Force 2004a).
 2 - MCL of 1,750 µg/L applies to sum of m-xylene, o-xylene, and p-xylene.

Table 5
SVOCs and PAHs in Groundwater
Spring 2005
EPA Methods SW8270C and SW8270C SIM (µg/L)
TRP Site 2 (Old Base Service Station)
Vandenberg AFB, California

Sample Location	Sample ID	Collection Date	SVOCs			PAHs		
			Naphthalene	2-Methylnaphthalene	All Other Target Analytes	Naphthalene	All Other Target Analytes	
		MDL ¹	1.6	1.8	N/A	0.024	N/A	
		PQL ¹	10	10	N/A	1.0	N/A	
2-MW-8	V2MW8M	02-May-05	22 g	25 g	ND	18 g	ND	

Data Validity Comment(s):

g - The data met prescribed criteria as detailed in the QAPP.

Definition(s):

- MDL - method detection limit
- µg/L - micrograms per liter
- N/A - not applicable
- ND - not detected; result is less than the MCL
- PAH - polynuclear aromatic hydrocarbon
- PQL - practical quantitation limit
- QAPP - Quality Assurance Project Plan
- SIM - selected ion monitoring
- SVOC - semivolatile organic compound

Note(s):

- 1 - Values from QAPP Addendum (U.S. Air Force 2004a).

Table 6
Summary of BGMP Key Contaminants of Concern
IRP Site 2 (Old Base Service Station)
Vandenberg AFB, California

	Benzene ($\mu\text{g/L}$) ^a																			
	Dec-99	Fall-00	Win-01	Spr-01	Sum-01	Fall-01	Win-02 ⁱ	Spr-02	Sum-02	Fall-02	Win-03	Spr-03	Sum-03	Fall-03	Win-04	Spr-04	Sum-04	Fall-04	Win-05	Spr-05
2-MW-1	ND	ND	ND	ND	NA	NA	NA	NA	NA	ND	NA	NA	NA	NA	NA	NA	NA	NA	NA	
2-MW-3	0.0465	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA	ND	ND	ND	NA	NA	NA	NA	NA	
2-MW-5	0.0675	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA	ND	NA	ND	NA	NA	NA	NA	NA	
2-MW-6	0.0445	ND	ND	ND	ND	ND	ND	ND	ND	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
2-MW-7	ND	ND	ND	ND	ND	ND	NA	0.69	NA	ND	NA	0.23	NA	0.32	NA	0.45	NA	NA	NA	
2-MW-8	0.375	3.5	4.4	NA	5.1	36	7.7	23	18	26	32.5	22.5	33	33.8	22	21	39	57	36	
2-MW-9	0.0485	ND	ND	ND	ND	ND	NA	ND	NA	ND	NA	ND	NA	ND	NA	NA	NA	NA	NA	
2-MW-10	0.0472	ND	ND	ND	ND	ND	NA	ND	NA	ND	NA	ND	NA	ND	NA	ND	NA	NA	NA	
2-MW-11	NA	NA	NA	ND	ND	ND	ND	ND	NA	NA	NA	NA	ND	NA	NA	NA	NA	NA	NA	
2-MW-12	NA	NA	NA	ND	ND	ND	ND	ND	NA	NA	NA	NA	ND	NA	NA	NA	NA	NA	NA	
OS-MW-1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	
OS-MW-2	NA	NA	NA	ND	ND	ND	NA	ND	NA	ND	NA	ND	NA	ND	NA	ND	NA	NA	NA	

	Toluene ($\mu\text{g/L}$) ^a																			
	Dec-99	Fall-00	Win-01	Spr-01	Sum-01	Fall-01	Win-02 ⁱ	Spr-02	Sum-02	Fall-02	Win-03	Spr-03	Sum-03	Fall-03	Win-04	Spr-04	Sum-04	Fall-04	Win-05	Spr-05
2-MW-1	ND	ND	ND	ND	NA	NA	NA	NA	NA	ND	NA	NA	NA	NA	NA	NA	NA	NA	NA	
2-MW-3	ND	ND	ND	ND	ND	ND	ND	ND	NA	ND	NA	0.44	NA	ND	NA	ND	NA	NA	NA	
2-MW-5	ND	ND	ND	ND	ND	ND	ND	ND	NA	ND	NA	NA	NA	NA	NA	ND	NA	NA	NA	
2-MW-6	ND	ND	ND	ND	ND	ND	ND	ND	NA	ND	NA	NA	NA	NA	NA	NA	NA	NA	NA	
2-MW-7	ND	ND	0.64	ND	ND	ND	NA	2.2	NA	1.2	NA	0.17	NA	ND	NA	ND	NA	NA	NA	
2-MW-8	2.06	5.3	11	NA	1.1	6.4	64	12	35	23	37	22.7	12.1	24.1	9.98	6.7	5.5	8.9	11	
2-MW-9	ND	ND	0.59	ND	ND	ND	NA	ND	NA	ND	NA	ND	NA	ND	NA	ND	NA	NA	NA	
2-MW-10	ND	ND	0.53	ND	ND	ND	NA	ND	NA	ND	NA	ND	NA	ND	NA	ND	NA	NA	NA	
2-MW-11	NA	NA	ND	ND	ND	ND	NA	NA	NA	NA	NA	NA	NA	ND	NA	ND	NA	NA	NA	
2-MW-12	NA	NA	NA	ND	ND	ND	ND	ND	NA	NA	NA	NA	ND	NA	NA	ND	ND	ND	NA	
OS-MW-1	ND	ND	ND	ND	ND	ND	ND	ND	NA	ND	ND	0.4	ND	ND	ND	ND	ND	ND	NA	
OS-MW-2	NA	NA	NA	ND	ND	ND	NA	ND	NA	ND	NA	ND	NA	ND	NA	ND	NA	NA	NA	

Table 6
Summary of BGMP Key Contaminants of Concern
IRP Site 2 (Old Base Service Station)
Vandenberg AFB, California

	Ethylbenzene ($\mu\text{g/L}$) ^a																			
	Dec-99	Fall-00	Win-00	Spr-01	Sum-01	Fall-01	Win-02 ⁱ	Spr-02	Sum-02	Fall-02	Win-03	Spr-03	Sum-03	Fall-03	Win-04	Spr-04	Sum-04	Fall-04	Win-05	Spr-05
2-MW-1	ND	ND	ND	ND	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
2-MW-3	ND	ND	ND	ND	ND	ND	ND	ND	NA	ND	NA	ND	NA	ND	NA	NA	NA	NA	NA	
2-MW-5	ND	ND	ND	ND	ND	ND	ND	ND	NA	ND	NA	0.20	NA	ND	NA	NA	NA	NA	NA	
2-MW-6	ND	ND	ND	ND	ND	ND	ND	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
2-MW-7	ND	ND	ND	ND	ND	ND	NA	2.4	NA	1.7	NA	0.1	NA	0.14	NA	0.29	NA	NA	NA	
2-MW-8	1.38	5.2	10	NA	8.7	4.9	62	12	37	31	36	34.7	32.3	26.9	34.1	20	19	34	39	26
2-MW-9	ND	ND	ND	ND	ND	ND	NA	ND	NA	ND	NA	ND	NA	ND	NA	NA	NA	NA	NA	
2-MW-10	ND	ND	ND	ND	ND	ND	NA	ND	NA	ND	NA	ND	NA	ND	NA	ND	NA	NA	NA	
2-MW-11	NA	NA	NA	ND	ND	ND	NA	NA	NA	NA	NA	NA	NA	ND	NA	NA	NA	NA	NA	
2-MW-12	NA	NA	NA	ND	ND	ND	NA	ND	NA	NA	NA	NA	NA	ND	NA	NA	NA	NA	NA	
OS-MW-1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	
OS-MW-2	NA	NA	NA	ND	ND	ND	NA	ND	NA	ND	NA	ND	NA	ND	NA	ND	NA	NA	NA	

	<i>m,p</i> -Xylenes ($\mu\text{g/L}$) ^b																			
	Dec-99	Fall-00	Win-01	Spr-01	Sum-01	Fall-01	Win-02 ⁱ	Spr-02	Sum-02	Fall-02	Win-03	Spr-03	Sum-03	Fall-03	Win-04	Spr-04	Sum-04	Fall-04	Win-05	Spr-05
2-MW-1	ND	ND	ND	ND	NA	NA	NA	NA	NA	ND	NA	NA	NA	NA	NA	NA	NA	NA	NA	
2-MW-3	ND	ND	ND	ND	ND	ND	ND	ND	NA	ND	NA	ND	NA	ND	NA	NA	NA	NA	NA	
2-MW-5	0.316	ND	ND	ND	ND	ND	ND	ND	NA	ND	NA	ND	NA	ND	NA	NA	NA	NA	NA	
2-MW-6	ND	ND	ND	ND	ND	ND	ND	NA	ND	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
2-MW-7	ND	4.6	ND	ND	ND	ND	NA	22	NA	17	NA	7.88	NA	8.08	NA	11	NA	NA	NA	
2-MW-8	6.26	29	42	NA	37	37	250	61	160	72	180	230	125	227	218	110	90	240	160	
2-MW-9	ND	ND	ND	ND	ND	ND	NA	ND	NA	ND	NA	ND	NA	0.17	NA	ND	NA	NA	NA	
2-MW-10	ND	ND	ND	ND	ND	ND	NA	ND	NA	ND	NA	ND	NA	ND	NA	ND	NA	NA	NA	
2-MW-11	NA	NA	NA	ND	ND	ND	NA	NA	NA	ND	NA	NA	NA	ND	NA	NA	NA	NA	NA	
2-MW-12	NA	NA	NA	ND	ND	ND	NA	ND	NA	ND	NA	NA	NA	ND	NA	NA	NA	NA	NA	
OS-MW-1	ND	ND	ND	ND	ND	ND	NA	ND	NA	ND	NA	ND	ND	ND	ND	ND	ND	ND	ND	
OS-MW-2	NA	NA	NA	ND	ND	ND	NA	ND	NA	ND	NA	ND	NA	ND	NA	ND	NA	NA	NA	

Table 6
Summary of BGMP Key Contaminants of Concern
IRP Site 2 (Old Base Service Station)
Vandenberg AFB, California

	o-Xylene (µg/L) ^b																			
	Dec-99	Fall-00	Win-01	Spr-01	Sum-01	Fall-01	Win-02 ⁱ	Spr-02	Sum-02	Fall-02	Win-03	Spr-03	Sum-03	Fall-03	Win-04	Spr-04	Sum-04	Fall-04	Win-05	Spr-05
2-MW-1	ND	ND	ND	ND	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
2-MW-3	ND	ND	ND	ND	ND	ND	ND	NA	ND	NA	ND	NA	ND	NA	ND	NA	NA	NA	NA	
2-MW-5	0.114	ND	ND	ND	ND	ND	ND	NA	ND	NA	ND	NA	ND	NA	ND	NA	NA	NA	NA	
2-MW-6	ND	ND	ND	ND	ND	ND	ND	NA	ND	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
2-MW-7	ND	ND	ND	ND	ND	4.9	NA	8.6	NA	6.4	NA	2.59	NA	2.97	NA	4.3	NA	NA	NA	
2-MW-8	2.21	6	14	NA	12	10	74	21	53	35	52	56.2	24.7	61.6	48.7	28	28	51	42	
2-MW-9	ND	ND	ND	ND	ND	ND	NA	ND	NA	ND	NA	ND	NA	ND	NA	ND	NA	NA	NA	
2-MW-10	ND	ND	ND	ND	ND	ND	NA	ND	NA	ND	NA	ND	NA	ND	NA	ND	NA	NA	NA	
2-MW-11	NA	NA	NA	ND	ND	ND	ND	NA	NA	NA	NA	NA	ND	NA	ND	NA	NA	NA	NA	
2-MW-12	NA	NA	NA	ND	ND	ND	ND	NA	NA	NA	NA	NA	ND	NA	ND	NA	NA	NA	NA	
OS-MW-1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	
OS-MW-2	NA	NA	NA	ND	ND	ND	NA	ND	NA	ND	NA	ND	NA	ND	NA	ND	NA	NA	NA	

	TPH as gasoline (mg/L)																			
	Dec-99	Fall-00	Win-01	Spr-01	Sum-01	Fall-01	Win-02 ⁱ	Spr-02	Sum-02	Fall-02	Win-03	Spr-03	Sum-03	Fall-03	Win-04	Spr-04	Sum-04	Fall-04	Win-05	Spr-05
2-MW-1	ND	ND	ND	ND	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
2-MW-3	ND	ND	ND	ND	ND	ND	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
2-MW-5	ND	ND	ND	ND	ND	ND	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
2-MW-6	ND	ND	ND	ND	ND	ND	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
2-MW-7	ND	ND	ND	ND	ND	0.27	NA	0.25	NA	0.15	NA	0.09	NA	0.09 ^e	NA	0.1	NA	NA	NA	
2-MW-8	0.0719	0.69	0.62	NA	0.88	0.64	4.9	1.2	2.8	2.3	3.6	2.72	2.12	2.27	2.55	1.5	1.2	2.3	NA	
2-MW-9	ND	ND	ND	ND	ND	NA	NA	ND	NA	ND	NA	ND	NA	0.02 ^c	NA	ND	NA	NA	NA	
2-MW-10	ND	ND	ND	ND	ND	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
2-MW-11	NA	NA	NA	ND	ND	ND	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
2-MW-12	NA	NA	NA	ND	ND	ND	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
OS-MW-1	ND	ND	ND	ND	ND	ND	NA	ND	NA	ND	NA	ND	NA	0.02 ^c	NA	ND	NA	NA	NA	
OS-MW-2	NA	NA	NA	ND	ND	ND	NA	ND	NA	ND	NA	ND	NA	0.03 ^e	NA	ND	NA	ND	NA	

Table 6
Summary of BGMP Key Contaminants of Concern
IRP Site 2 (Old Base Service Station)
Vandenberg AFB, California

	Naphthalene (µg/L)																			
	Dec-99	Fall-00	Win-01	Spr-01	Sum-01	Fall-01	Win-02 ⁱ	Spr-02	Sum-02	Fall-02	Win-03	Spr-03	Sum-03	Fall-03	Win-04	Spr-04	Sum-04	Fall-04	Win-05	Spr-05
2-MW-1	0.124	ND	ND	ND	ND	ND	NA	ND	NA	ND	NA	ND	NA	ND	NA	ND	NA	ND	NA	ND
2-MW-3	ND	ND	ND	ND	ND	ND	ND	ND	NA	ND	NA	ND	NA	ND	NA	ND	NA	ND	NA	ND
2-MW-5	ND	ND	ND	ND	ND	ND	ND	ND	NA	ND	NA	ND	NA	ND	NA	ND	NA	ND	NA	ND
2-MW-6	ND	ND	ND	ND	ND	ND	ND	ND	NA	ND	NA	ND	NA	ND	NA	ND	NA	ND	NA	ND
2-MW-7	ND	ND	ND	ND	ND	ND	ND	ND	NA	ND	NA	ND	NA	ND	NA	ND	NA	ND	NA	ND
2-MW-8	1.07	ND	ND	NA	5.3	ND	21	10	18	12	16	15.2	18.5	25.7	28.8	9.7	21	17	22	
2-MW-9	0.205	ND	ND	ND	ND	ND	ND	ND	NA	ND	NA	ND	NA	ND	NA	ND	NA	ND	NA	ND
2-MW-10	0.137	ND	ND	ND	ND	ND	ND	ND	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-MW-11	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-MW-12	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
OS-MW-1	ND	ND	ND	ND	ND	ND	ND	ND	NA	ND	NA	ND	NA	ND	NA	ND	NA	ND	NA	ND
OS-MW-2	NA	NA	NA	NA	NA	NA	NA	NA	ND	NA	NA	ND	NA	ND	NA	ND	NA	ND	NA	ND

	Dissolved Aluminum (µg/L) ^d																			
	Dec-99	Fall-00	Win-01	Spr-01	Sum-01	Fall-01	Win-02 ⁱ	Spr-02	Sum-02	Fall-02	Win-03	Spr-03	Sum-03	Fall-03	Win-04	Spr-04	Sum-04	Fall-04	Win-05	Spr-05
2-MW-1	NA	238	380	293	ND	464	662	NA	288	NA	ND	NA	383	NA	464	NA	408	NA	386	NA
2-MW-3	NA	ND	ND	ND	ND	ND	118	ND	NA	ND	NA	ND	NA	17.8	NA	ND	NA	ND	NA	ND
2-MW-5	NA	ND	ND	ND	ND	ND	209	NA	ND	NA	ND	NA	ND	NA	21.9	NA	ND	NA	ND	NA
2-MW-6	NA	399	ND	ND	ND	ND	229	678	NA	374	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-MW-7	NA	470	373	408	666	1,180	NA	200	NA	475	NA	519	NA	224	NA	574	NA	662	NA	662
2-MW-8	NA	1,380	1,260	NA	1,650	1,970	13,500	12,700	12,300	3,970	7,410	8,600	8,320	9,300	6,880	5,330	5,100	5,420	5,070	5,430
2-MW-9	NA	ND	268	ND	483	548	NA	ND	NA	265	NA	284	NA	132	NA	ND	NA	ND	104	NA
2-MW-10	NA	ND	ND	232	277	651	NA	341	NA	622	NA	939	NA	505	NA	213	NA	521	NA	521
2-MW-11	NA	NA	ND	ND	341	242	ND	ND	ND	33.2 ^c	NA	26.2	23	NA	ND	ND	ND	ND	ND	ND
2-MW-12	NA	NA	NA	ND	ND	284	186	ND	ND	26.6 ^c	NA	33.6	19	NA	ND	ND	ND	ND	ND	ND
OS-MW-1	NA	ND	ND	ND	ND	313	NA	ND	NA	ND	NA	42.8	NA	44.6	NA	ND	NA	ND	NA	ND
OS-MW-2	NA	NA	ND	ND	ND	211	NA	ND	NA	ND	NA	20.1	NA	26.9	NA	ND	NA	ND	NA	ND

Table 6
Summary of BGMP Key Contaminants of Concern
IRP Site 2 (Old Base Service Station)
Vandenberg AFB, California

	Dissolved Beryllium ($\mu\text{g/L}$) ^e																			
	Dec-99	Fall-00	Win-01	Spr-01	Sum-01	Fall-01	Win-02 ^j	Spr-02	Sum-02	Fall-02	Win-03	Spr-03	Sum-03	Fall-03	Win-04	Spr-04	Sum-04	Fall-04	Win-05	Spr-05
2-MW-1	NA	ND	ND	ND	ND	NA	ND	NA	ND	NA	ND	NA	ND	NA	ND	NA	ND	NA	NA	
2-MW-3	NA	ND	ND	ND	ND	ND	ND	NA	ND	NA	ND	NA	ND	NA	ND	NA	ND	NA	NA	
2-MW-5	NA	ND	ND	ND	ND	NA	ND	NA	ND	NA	ND	NA	ND	NA	ND	NA	ND	NA	NA	
2-MW-6	NA	ND	ND	ND	ND	NA	ND	NA	ND	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
2-MW-7	NA	ND	ND	ND	ND	NA	ND	NA	ND	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
2-MW-8	NA	ND	ND	ND	ND	NA	ND	NA	ND	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
2-MW-9	NA	ND	ND	ND	ND	NA	ND	NA	ND	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
2-MW-10	NA	ND	ND	ND	ND	NA	ND	NA	ND	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	
2-MW-11	NA	NA	NA	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	
2-MW-12	NA	NA	NA	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	
OS-MW-1	NA	ND	ND	ND	ND	NA	ND	NA	ND	NA	ND	NA	ND	NA	ND	NA	ND	NA	NA	
OS-MW-2	NA	NA	NA	ND	ND	NA	ND	NA	ND	NA	ND	NA	ND	NA	ND	NA	ND	NA	NA	

	Dissolved Cadmium ($\mu\text{g/L}$) ^f																			
	Dec-99	Fall-00	Win-01	Spr-01	Sum-01	Fall-01	Win-02 ^j	Spr-02	Sum-02	Fall-02	Win-03	Spr-03	Sum-03	Fall-03	Win-04	Spr-04	Sum-04	Fall-04	Win-05	Spr-05
2-MW-1	10.8	55.4	12.4	12.7	10.2	12.4	11.1	NA	10.7	NA	79.6	NA	13.1	NA	14.1	NA	12	NA	11	NA
2-MW-3	2.32	12	ND	4.13	6.6	2.05	5.81	7	5.98	NA	4.17	NA	ND	NA	ND	NA	ND	NA	ND	NA
2-MW-5	ND	4.9	298	141	59.3	137	4.74	NA	13.6	NA	6.68	NA	4.5	NA	3.4	NA	14.1	NA	4.96	NA
2-MW-6	4.31	ND	41	20.5	8.96	30.2	5.22	NA	4.66	NA										
2-MW-7	2.79	4.4	6.39	6.62	6.78	29.7	17.5	NA	1.94	NA	8.63	NA	7.6	NA	6.8	NA	10.3	NA	7.06	NA
2-MW-8	22.4	674	35.2	NA	34	38.7	35	37	31.8	26.4	38.9	41.6	39.8	38.9	39.6	40.5	40.2	39.5	39.5	36.8
2-MW-9	42.3	34	74.5	76.5	81.1	96	72.1	NA	73.4	NA	12.4	NA	85.8	NA	83.5	NA	84.4	NA	87.2	NA
2-MW-10	60.2	80.4	78.8	76.3	77.4	88.1	71.8	NA	80.5	NA	11.3	NA	59.7	NA	69.9	NA	64.5	NA	71.3	NA
2-MW-11	NA	NA	NA	5.87	5.39	7.8	4.33	5.11	5.8	4.56	5.74	5	NA	6.5	4.9	NA	4.59	7.1	8.21	3.2
2-MW-12	NA	NA	NA	36.3	36.1	31.6	ND	12.7	17.4	ND	8.12	1.9	NA	ND	ND	NA	ND	ND	ND	ND
OS-MW-1	38.1	85.6	547	54.5	50.8	60.5	46.6	NA	58.8	NA	63.2	NA	64.7	NA	73.8	NA	64.9	NA	72.3	NA
OS-MW-2	NA	NA	NA	6.82	13.9	2.56	10.9	NA	10.3	NA	10.4	NA	9.8	NA	5.2	NA	2.25	NA	2.52	NA

Table 6
Summary of BGMP Key Contaminants of Concern
IRP Site 2 (Old Base Service Station)
Vandenberg AFB, California

	Dissolved Selenium ($\mu\text{g/L}$) ^a												Dissolved Thallium ($\mu\text{g/L}$) ^b											
	Dec-99	Fall-00	Win-01	Spr-01	Sum-01	Fall-01	Win-02 ⁱ	Spr-02	Sum-02	Fall-02	Win-03	Spr-03	Sum-03	Fall-03	Win-04	Spr-04	Sum-04	Fall-04	Win-05	Spr-05				
2-MW-1	NA	39.8	35.8	32.4	37.6	43.8	32	NA	23.9	NA	127	NA	42.9	NA	35	NA	40.1	NA	39.4	NA				
2-MW-3	NA	ND	ND	ND	ND	ND	ND	ND	ND	NA	23.1	NA	ND	NA	ND	NA	ND	ND	ND	NA				
2-MW-5	NA	ND	ND	14.9	7.98	10.7	ND	NA	ND	NA	47.6	NA	62.6	NA	16.9	NA	77.6	NA	25	NA				
2-MW-6	NA	31.9	29.8	28.5	35.9	6.83	30.1	NA	ND	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA				
2-MW-7	NA	35.1	28.8	34.2	31.2	46.1	31.3	NA	22.3	NA	63.1	NA	57.5	NA	27.2	NA	37.3	NA	37	NA				
2-MW-8	NA	37.7	36.3	NA	37.5	43.2	ND	35.2	ND	21.3	88.0	26.7	43.1	30.7	26.2	35.9	32.2	39.4	41	39.4				
2-MW-9	NA	43.4	37.5	40.3	42.0	47.8	31.1	NA	31.2	NA	88.6	NA	56.7	NA	33.4	NA	44.7	NA	48.3	NA				
2-MW-10	NA	23.5	14.3	20.9	32.3	27.4	22.6	NA	9.67	NA	20.8	NA	23.9	NA	21.1	NA	24.1	NA	28.8	NA				
2-MW-11	NA	NA	NA	25.3	24.1	25.2	25.8	55	23.7	87.5	148	36.3	NA	36.3	38.6	NA	42.8	44.1	45.7	45.6				
2-MW-12	NA	NA	NA	ND	ND	ND	ND	ND	40.7	ND	52.1	ND	ND	ND	ND	ND	ND	ND	ND	ND				
OS-MW-1	NA	14.8	9.11	16.3	15.8	13.6	ND	NA	ND	NA	58.3	NA	58	NA	17.1	NA	15.2	NA	13.3	NA				
OS-MW-2	NA	NA	NA	10.7	13.6	ND	ND	NA	ND	NA	34.4	NA	12.3	NA	8.3	NA	5.9	NA	6.56	NA				

Table 6
Summary of BGMP Key Contaminants of Concern
IRP Site 2 (Old Base Service Station)
Vandenberg AFB, California

Definition(s):	
BTV	- background threshold value
MCL	- maximum contaminant level
$\mu\text{g/L}$	- micrograms per liter
mg/L	- milligrams per liter
NA	- not analyzed
ND	- not detected; result is less than the method detection limit
TPH	- total petroleum hydrocarbons

Note(s):	
Bold type indicates results that were above the MCL.	
Shading indicates results that were above the 95th percentile BTV.	
a	- The MCLs for benzene, toluene, and ethylbenzene are 1, 150, and 300 $\mu\text{g/L}$, respectively.
b	- The MCL of 1,750 $\mu\text{g/L}$ applies to the sum of m-xylene, o-xylene, and p-xylene.
c	- The data were qualified for blank contamination during the validation process. The laboratory method blank showed the same order of magnitude as the sample results. The sample results are strongly suspected to be false positive.
d	- The BTV and MCL for aluminum are 1,200 and 1,000 $\mu\text{g/L}$, respectively.
e	- The BTV and MCL for beryllium are 0.3 and 4 $\mu\text{g/L}$, respectively.
f	- The BTV and MCL for cadmium are 5 and 5 $\mu\text{g/L}$, respectively.
g	- The BTV and MCL for selenium are 3 and 50 $\mu\text{g/L}$, respectively.
h	- The BTV and MCL for thallium are 1 and 2 $\mu\text{g/L}$, respectively.
i	- Dedicated MicroPurge pumps were installed in Site 2 wells during winter 2002.

APPENDIX A

PURGE RECORDS



TETRA TECH, INC.
101 S. Flower Street, STE 100
San Bernadino, CA 92310
Telephone (800) 681-3100
Telex 605 681-3101

GROUNDWATER MONITORING WELL

FIELD DATA LOG SHEET - PURGING

Page 1 of 1

DATE 5/2/05 SITE NUMBER 2

PROGRAM NAME B.G.M.P

MONITORING WELL IDENTIFICATION 2-MJ-8

SAMPLE ID. U2MJ8

STATIC WATER LEVEL (ft. b.s.e.) 4.97

WATER COLUMN (ft.) 9.80

PUMP & TUBING (ft. a.) 1.48

TOTAL WELL DEPTH (ft. b.s.e.) 34.9

TUBING DIAMETER (in.) 3/8"

3 V.C.

PURGING DEVICE MICROPURE DEDICATED PUMP

SAMPLING DEVICE MICROPURE DEDICATED PUMP

PTD READING IN CASTING (ppm) - (initial) - (final) - (creased to) -

PTD READING IN BREATHING ZONE (ppm) - (initial) - (final) - (creased to) -

SED (ft.) 4.56 Brad Brad

SAMPLER'S SIGNATURE Brad

Brad

Time	Activity	Water Level (ft. b.s.e.)	Temp (Deg C)	EC (micromhos/cm)	pH	Turbidity (NTU)	Dissolved Oxygen (mg/L)	ORP (mV)	Color	Volume Purged (L)	Pump & Tubing Volumes Parged	Flow Rate (GPM)
12:15	Begin Purge	23.16	19.73	11344	6.68	2.89	5.41	175.1	clear	0.7	0.14	0.47
12:20		23.19	19.66	12.062	5.92	2.09	3.43	242.6	clear	1.40	0.94	
12:25		23.15	19.88	12170	5.38	1.44	2.52	272.6	clear	2.10	1.41	
12:30		23.17	19.94	12219	5.15	1.44	1.78	281.7	clear	2.80	1.89	
12:35		23.21	20.02	12280	5.06	1.37	1.43	285.7	clear	3.50	2.36	
12:40		23.19	20.10	13339	4.94	1.65	1.29	290.1	clear	4.20	2.83	
12:45		23.19	20.04	12326	4.91	1.31	1.19	292.1	clear	4.90	3.31	
12:50		23.27	19.93	12321	4.81	1.29	1.12	292.2	clear	5.60	3.78	
12:55	Purge											
13:00	Sample	23.26	-									

Form number 71-0-049 (602)

PTD (ppm)

Taken immediately before sampling

WATER LEVEL (ft. b.s.e.) AT TIME OF SAMPLING: 23.26

Comments: P.D. = 27.81

PARAMETERS FOR WATER QUALITY STABILIZATION		
Temperature $\pm 1^\circ\text{C}$ (1.8°F)	Conductivity $\pm 5\%$	
pH ± 0.1	Turbidity 5 NTU	

Note: All water levels and pump depths are measured from the ground to the top of the well center. If vertical or horizontal distance exists between the TD and the well center, the TD must be periodically monitored during sampling activities and the TD must be recalculated in the logbook.



TETRA TECH, INC.
4213 State Street, STE 100
Santa Barbara, CA 93110
Telephone (805) 681-3100
Telefax (805) 681-3108

**GROUNDWATER MONITORING WELL
FIELD DATA LOG SHEET - PURGING**

Page 1 of 1

DATE 5/2/05 PROGRAM NAME BG MP

MONITORING WELL IDENTIFICATION U2 MW-11

SAMPLE I.D. U2 MW-11

STATIC WATER LEVEL (ft htoc) 30.78

WATER COLUMN (feet) 24.18

PUMP & TUBING (V) (L) 0.87

SITE NUMBER 2

PURGING DEVICE MICROPIGEON DYNAMIC PUMP

SAMPLING DEVICE MICROPIGEON DYNAMIC PUMP

PID READING IN CASING (ppm) —

PID READING IN BREATHING ZONE (ppm) —

(initial) — (vented to) —

(initial) — (vented to) —

SBD (feet) 54.980

TOTAL WELL DEPTH (ft htoc) 31.8"

TUBING DIAMETER (in) 2.61

SAMPLER'S SIGNATURE Bast Slocum

Time Activity Water Level (ft htoc) Temp (Deg. C) EC (μ hos/cm) pH Turbidity (NTU) Dissolved Oxygen (mg/L) ORP (mV) Color Pump & Tubing Volumes purged (L) Pump Purge Volume (L) Flow Rate (LPM)

1446 Begin Purge 31.23 19.00 12.183 6.0 4.60 2.81 85.4 Clear 1.0 1.14 0.20

1450 31.55 18.90 12.175 5.99 4.62 1.57 83.4 Clear 2.0 2.30 —

1455 31.67 18.93 12.194 5.97 4.08 1.24 81.9 Clear 2.40 2.75 —

1457 End Purge 31.89 — — — — — — — — — — —

1505 Sample 31.89 — — — — — — — — — —

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Form number Tt-O-049 (8/02)

Fe+2 (ppm) —

Taken immediately before sampling.

WATER LEVEL (ft htoc) AT TIME OF SAMPLING: 31.89

Comments:

PH = 4.6.37

PARAMETERS FOR WATER QUALITY STABILIZATION
Temperature $\pm 1^\circ\text{C}$ (1.8 F)
pH ± 0.1
Conductivity $\pm 5\%$
Turbidity $\pm 5\text{ NTUs}$

Note: All water levels and pump depths are measured from the notch in the top of the well casing. If volatiles are detected above background in the breathing zone during the initial screening, the breathing zone will be periodically monitored during purging and sampling activities and the PID readings will be recorded in the logbook.



TETRATEC, INC.
4213 State Street, SITE 100
Santa Barbara, CA 93110
Telephone (805) 681-3100
Telefax (805) 681-3108

GROUNDWATER MONITORING WELL FIELD DATA LOG SHEET - PURGING

Page 1 of 1

PROGRAM NAME	B-GMP		SITE NUMBER	2								
DATE	5/12/05		PURGING DEVICE	MICROPIGUE DEDICATED PUMP								
MONITORING WELL IDENTIFICATION	2-MW-12		SAMPLING DEVICE	MICROPIGUE DEDICATED PUMP								
SAMPLE ID.	V2MW12		PID READING IN CASING (ppm)	(initial)	(ended to)							
STATIC WATER LEVEL (ft btoc)	27.38		PID READING IN BREATHING ZONE (ppm)	(initial)	(ended to)							
WATER COLUMN (feet)	40.4		SED (feet)	31.16								
PUMP & TUBING (in) (L)	0.98		SAMPLER'S SIGNATURE	Bob Grove B.G.								
TOTAL WELL DEPTH (ft btoc)	67.8											
TUBING DIAMETER (in)	3/8"											
3 V (L)	2.95											
Time	Activity	Water Level (ft btoc)	Temp (Deg C)	EC (µmhos/cm)	pH	Turbidity (NTU)	Dissolved Oxygen (mg/L)	ORP (mV)	Color	Volume Purged (L)	Pump Tubing Volumes Purged	Flow Rate (lpm)
1059	Begin Purge	27.76										0.22
1103		27.94	19.54	6537	954	6.6	3.70	61.2	Clear	0.88	0.89	
1107		28.20	19.50	6718	9.60	6.3	2.31	42.8		1.76	1.79	
1111		28.25	19.50	6933	9.38	4.3	2.05	41.2		2.64	2.69	
1115		28.28	19.57	7118	9.19	9.2	1.92	39.2		3.52	3.59	
1119		28.37	19.61	7274	8.96	13.7	1.78	42.4		4.40	4.49	
1123		28.43	19.65	7386	8.71	13.8	1.68	44.6		5.28	5.39	
1124	End Purge											
1130	Sample											

Form number 77-0-049 (6/02) Fe+2 (ppm) — Taken immediately before sampling.

WATER LEVEL (ft btoc) AT TIME OF SAMPLING: 29.64

Comments: PID: 59.80

PARAMETERS FOR WATER QUALITY STABILIZATION
 Temperature ± 1 C (1.8 F) Conductivity $\pm 5\%$
 pH ± 0.1 Turbidity 5 NTUs

Note: All water levels and pump depths are measured from the notch in the top of the well casing. If volatiles are detected above background in the breathing zone during the initial screening, no breathing zone will be periodically monitored during routine and emergency activities and the PID readings will be recorded in the logbook.

APPENDIX B

CHAIN-OF-CUSTODY RECORDS



TETRA TECH, INC.
4213 State Street, Suite 100
Santa Barbara, CA 93110

Phone (805) 681-3100
FAX (805) 681-3108

SHIPPED TO: EMAX LABS
1835 West 205th St.
Torrance, CA 90501

B3) Vwv1-33

CHAIN OF CUSTODY RECORD

05 E011

DATE 2 MAY 2005 PAGE 1 OF 4

ANALYTICAL METHODS				OBSERVATIONS/COMMENTS:
SAMPLE ID	DATE	TIME	MATRIX TYPE	
V2mw12F	5/2/05	1130	WP	
V2mw11F	5/2/05	1305	P	
V2mw8m	5/2/05	1300	G16	
V2mw8F	5/2/05	1305	P	
V02TB1021	5/3/05	0810	G2	
				Filtered Sample
				Number of Containers
				Matrix Type
				Container Type
				Site
				Turnaround Time:
				Standard

APPENDIX C

SUPPORTING TABLES

Sample Location	Wi-03	Sp-03	Su-03	Fa-03	Wi-04	Sp-04	Su-04	Fa-04	Wi-05	Sp-05
2-MW-1	0.204	NA	ND	NA	ND	NA	ND	NA	0.153	NA
2-MW-3	ND	NA	ND	NA	ND	NA	ND	ND	ND	NA
2-MW-5	ND	NA								
2-MW-7	ND	NA	ND	NA	ND	NA	ND	NA	0.195	NA
2-MW-8	0.110	0.23	ND	ND	ND	ND	ND	0.126	ND	ND
2-MW-9	ND	0.18	ND	NA	ND	NA	ND	NA	0.191	NA
2-MW-10	ND	0.17	ND	NA	ND	NA	ND	NA	0.11	NA
2-MW-11	ND	NA	NA	ND	ND	NA	ND	0.138	ND	ND
2-MW-12	ND	NA	NA	ND	ND	NA	ND	ND	ND	ND
OS-MW-1	ND	NA								
OS-MW-2	ND	NA								

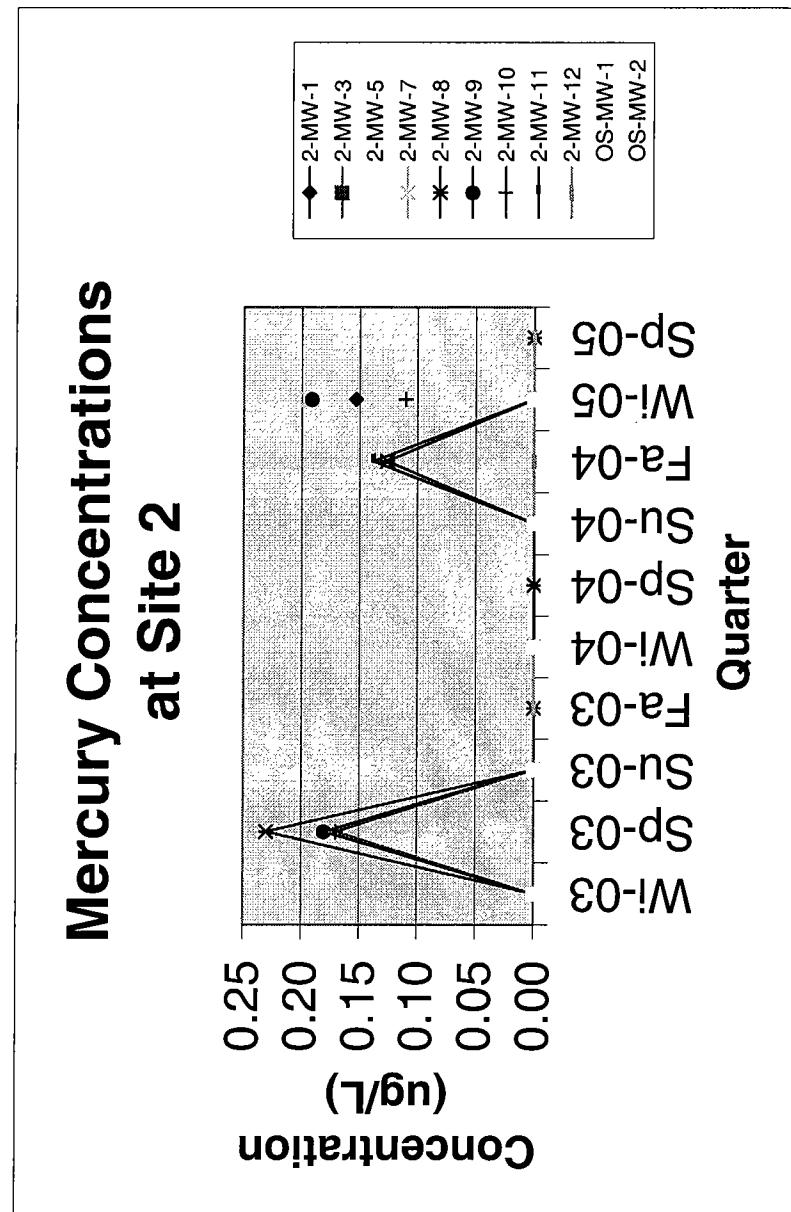


Figure C-1. Mercury Concentrations at Site 2